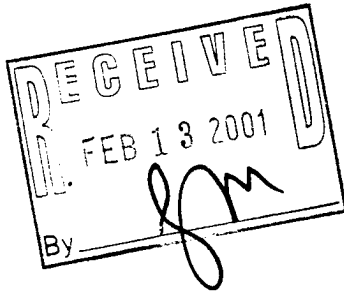# REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 2-5-01	3. REPORT TYPE AND DATES COVERED Final Report 7/1/95-6/30/00

4. TITLE AND SUBTITLE

Final Report: Nonlinear Analysis in the Science of Materials

5. FUNDING NUMBERS

DAAH04-95-1-0286

6. AUTHOR(S)

David Kinderlehrer

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Carnegie Mellon University
Department of Mathematical Sciences
5000 Forbes Avenue
Pittsburgh, PA 15213

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U. S. Army Research Office
P. O. Box 12211
Research Triangle Park, NC 27709-2211

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

ARO 34218.1-CI-AAS

11. SUPPLEMENTARY NOTES

The view, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This grant supported in part the work of five graduate students at Carnegie Mellon University: Christopher Larsen, Robert Thrash, William Dugan, Mikil Foss, and Steven Pav.

20010302 108

RECEIVED
FEB 13 2001
By

14. SUBJECT TERMS

graduate training in nonlinear analysis, numerical analysis, stochastic analysis

15. NUMBER OF PAGES

2

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UL

(1)   Foreward

This grant supported in part the work of five graduate students at Carnegie Mellon University: Christopher Larson, Robert Thrash, William Dugan, Mikil Foss, and Steven Pav.

(4)   Main problems studied

The students studied questions in nonlinear analysis, stochastic analysis, and numerical analysis.

(5)   Summary of most important results

(1995-1996) Robert Thrash has completed the courses and qualifying exam required for the Ph.D. degree in mathematical finance. Beginning in the fall of 1997, he took a leave of absence from Carnegie Mellon University to become a research scientist for Bank of America. He continues to work on a dissertation, centered around building a model for energy futures, and maintains regular contact with his thesis advisor, Steven Shreve.

(1995-1996) Christopher Larson. Larson studied. Variational problems involving bulk and surface energies that model problems in image segmentation, fracture mechanics, and optimal design of composite materials.

Results include
-- a proof of finiteness of crack sites and discontinuities in image segmentation,
-- a general result concerning representation of effective bulk energies when there is interaction between bulk and surface energies;
-- regularity and geometric restrictions on optimal composites of two materials.

List of all publications and technical reports.

1. "Quasiconvexification in $W^{1,1}$ and optimal jump microstructure in BV relaxation," SIAM J. Math. Anal. 29 (1998), pp. 823-848;

2. "A new proof of regularity for two-shaded image segmentations," Manuscripta Math. 96 (1998), pp. 247-262;

3. "Distance between components in optimal design problems with perimeter penalization," Ann. Scuola Norm. Sup. Pisa 28 (1999), pp. 641-649;

4. "On the representation of effective energy densities," Control, Optimisation and Calculus of Variations, to appear;

5. "On the connected components of edges in image segmentation," preprint;

6. "Uniqueness of steady-states and asymptotic behavior of solutions of a liquid junction model with insulation," (with R. Lui) preprint;

7. "Regularity of components in optimal design problems with perimeter penalization," preprint.

He is presently a tenure track assistant professor at Worcester Polytechnic Intsitute.

(1996-1997) William Dugan left after one year without completing a degree.

(1997-1998 and August 1999) Mikil Foss was supported by the grant during the 1997 - 1998 academic year, his first year of graduate studies. This support enabled him to take extra classes and get started on his research early. During the 1998 - 1999 academic year, he began working on Lavrentiev's phenomenon in the Calculus of Variations, i.e. situations in which the infimum of a functional is sensitive to changes in the Sobolev exponent for the class of admissible functions. He has shown, by explicit examples, that the dependence of the infimum on the Sobolev exponent can be an arbitrary monotonic function. He is currently investigating Lavrentiev's phenomenon for certain problems in two and three dimensional nonlinear elasticity. He will finish his Ph.D thesis, under the direction of W. Hrusa and V. Mizel, during the spring of 2001.

(June 2000) Steven Pav This past six months Steven has been working on algorithms for the automatic generation of meshes suitable for finite element applications. This problem very challenging in dimensions greater than two, and Steven recognized that an algorithm we were developing for two and possibly three dimensions could be extended to arbirary dimension with very little change. Steven currently writing up proofs of correctness of his algorithm and developing code to implement his ideas. The work will be published as part of his thesis.

Paticipating Personel: G. Blelloch (CS), S. Pav, N. Walkington (math)